Enhancing the electro-mechanical properties of polydimethylsiloxane elastomers through blending with poly(dimethylsiloxane-co-methylphenylsiloxane) copolymers Acknowledgments

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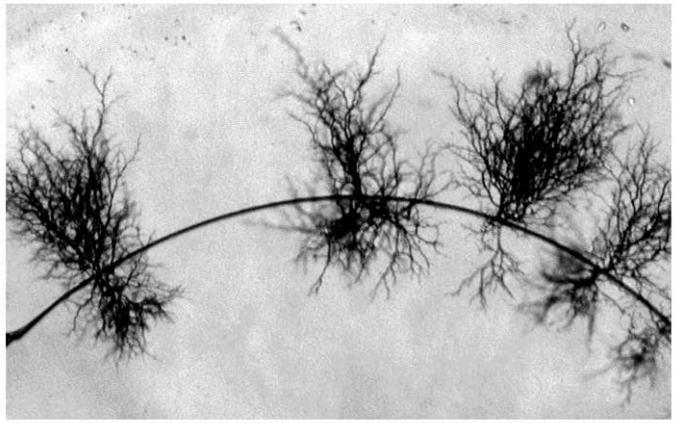
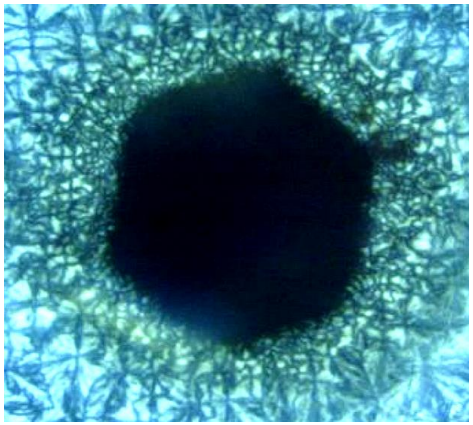
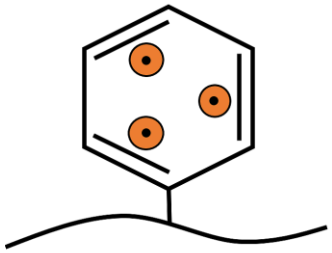


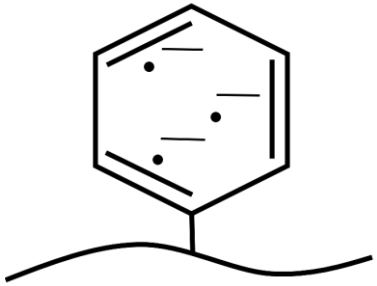
Electrical treeing



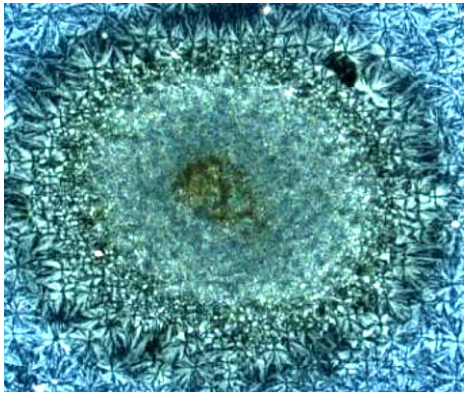
Failure of insulation material



Phenyl group - electron-trapping effect



Disturbance of cloud of π-electrons - anion radicals



Voltage stabiliser

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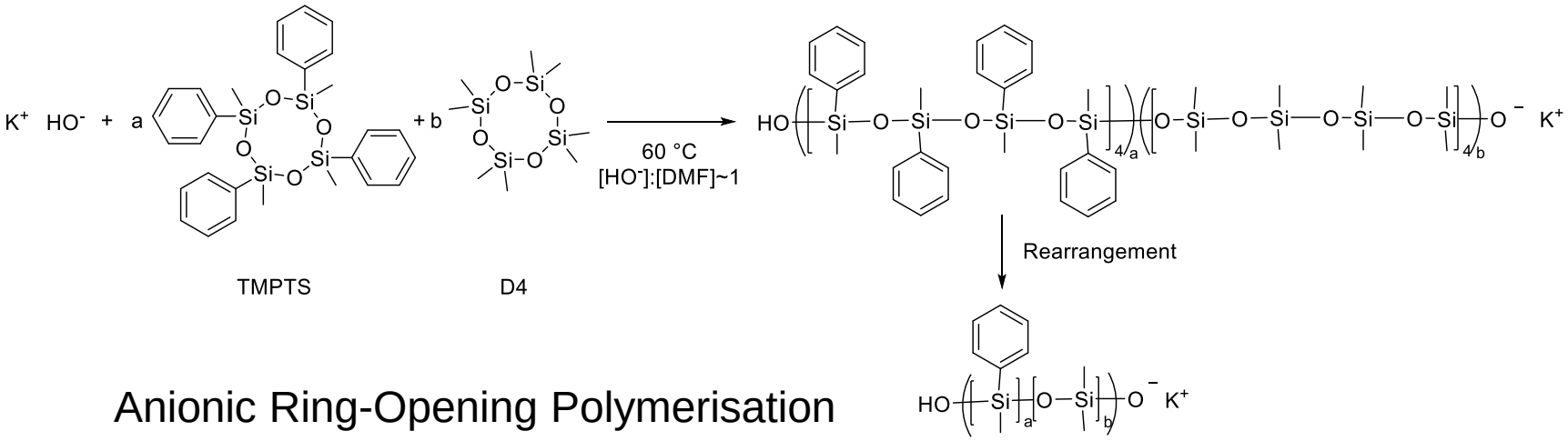
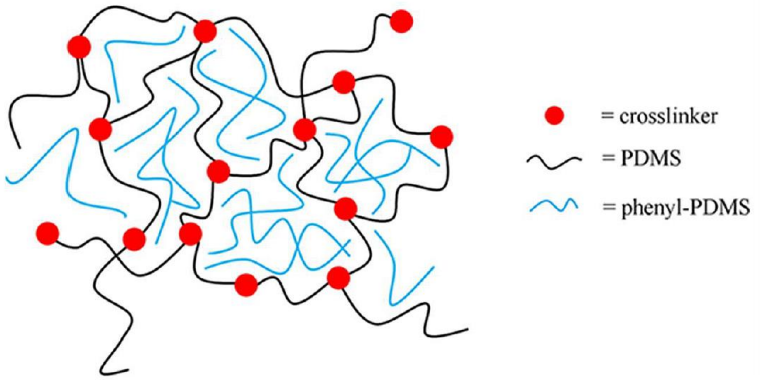
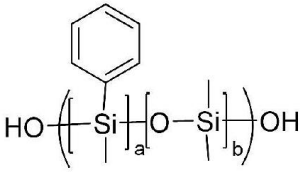


Anionic Ring-Opening Polymerisation

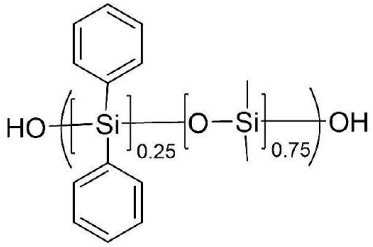




PDT_ba

a+b = 1

a=0.25, 0.50, 0.75



PDO_7525

Phenyl-PDMS copolymer in PDMS matrix

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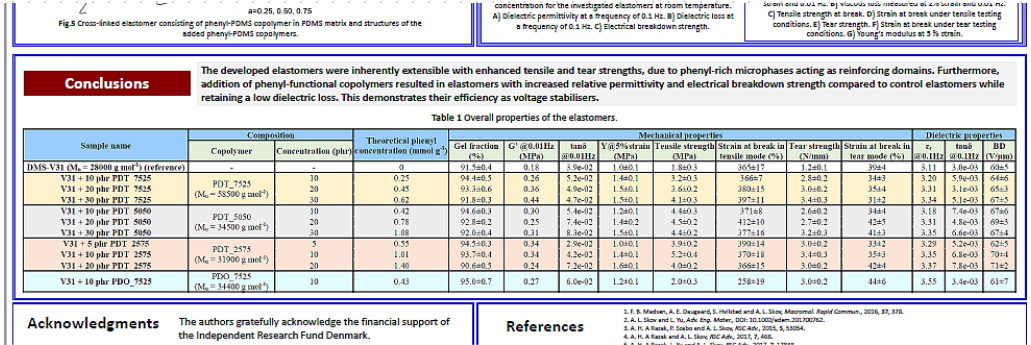
Thank you



a=0.25, 0.50, 0.75

Fig.5 Cross-linked elastomer consisting of phenyl-PDMS copolymer in PDMS matrix and structures of the added phenyl-PDMS copolymers.

concentration for the investigated elastomers at room temperature. A) Dielectric permittivity at a frequency of 0.1 Hz. B) Dielectric loss at a frequency of 0.1 Hz. C) Electrical breakdown strength.

C) Tensile strength at break. D) Strain at break under tensile testing conditions. E) Tear strength. F) Strain at break under tear testing conditions. G) Young's modulus at 5 % strain.

Conclusions

The developed elastomers were inherently extensible with enhanced tensile and tear strengths, due to phenyl-rich microphases acting as reinforcing domains. Furthermore, addition of phenyl-functional copolymers resulted in elastomers with increased relative permittivity and electrical breakdown strength compared to control elastomers while retaining a low dielectric loss. This demonstrates their efficiency as voltage stabilisers.

Table 1 Overall properties of the elastomers.

Sample name	Composition		Theoretical phenyl concentration (mmol g^{-1})	Mechanical properties							Dielectric properties		
	Copolymer	Concentration (phr)		Gel fraction (%)	G' @0.01Hz (MPa)	tanδ @0.01Hz	Y@5%strain (MPa)	Tensile strength (MPa)	Strain at break in tensile mode (%)	Tear strength (N/mm)	Strain at break in tear mode (%)	ε_r @0.1Hz	tanδ @0.1Hz	BD (V/μm)
DMS-V31 (M_n = 28000 g mol^{-1}) (reference)	-	-	0	91.5±0.4	0.18	3.9e-02	1.0±0.1	1.8±0.3	365±17	1.2±0.1	30±4	3.11	3.0e-03	60±5
V31 + 10 phr PDT_7525	PDT_7525 (M_n = 58500 g mol^{-1})	10	0.25	94.4±0.5	0.26	5.2e-02	1.4±0.1	3.2±0.3	366±7	2.8±0.2	34±3	3.20	5.9e-03	64±6
V31 + 20 phr PDT_7525		20	0.45	93.3±0.6	0.36	4.9e-02	1.5±0.1	3.6±0.2	380±15	3.0±0.2	35±4	3.31	3.1e-03	65±3
V31 + 30 phr PDT_7525		30	0.62	91.8±0.3	0.44	4.7e-02	1.5±0.1	4.1±0.3	397±11	3.4±0.3	31±2	3.34	5.1e-03	67±5
V31 + 10 phr PDT_5050	PDT_5050 (M_n = 34500 g mol^{-1})	10	0.42	94.6±0.3	0.30	5.4e-02	1.2±0.1	4.4±0.3	371±8	2.6±0.2	34±4	3.18	7.4e-03	67±6
V31 + 20 phr PDT_5050		20	0.78	92.8±0.2	0.25	7.4e-02	1.4±0.2	4.5±0.2	412±10	2.7±0.2	42±5	3.31	4.8e-03	69±3
V31 + 30 phr PDT_5050		30	1.08	92.0±0.4	0.31	8.3e-02	1.5±0.1	4.4±0.2	377±16	3.2±0.3	41±3	3.35	6.6e-03	67±4
V31 + 5 phr PDT_2575	PDT_2575 (M_n = 31900 g mol^{-1})	5	0.55	94.5±0.3	0.34	2.9e-02	1.0±0.1	3.9±0.2	390±14	3.0±0.2	33±2	3.29	5.2e-03	62±5
V31 + 10 phr PDT_2575		10	1.01	93.7±0.4	0.34	4.2e-02	1.4±0.1	5.2±0.4	370±18	3.4±0.3	35±3	3.35	6.8e-03	70±4
V31 + 20 phr PDT_2575		20	1.40	90.6±0.5	0.24	7.2e-02	1.6±0.1	4.0±0.2	366±15	3.0±0.2	42±4	3.37	7.8e-03	71±2
V31 + 10 phr PDO_7525	PDO_7525 (M_n = 34400 g mol^{-1})	10	0.43	95.0±0.7	0.27	6.0e-02	1.2±0.1	2.0±0.3	258±19	3.0±0.2	44±6	3.55	3.4e-03	61±7

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